1 Pupose

To have the student become aware of the types of strategic and tactical nuclear weapons and how they function.

2 Duration

50 min.

3 Objectives

Students should be able to:

- Explain the nuclear fission process.
- Explain nuclear fusion.
- Explain how both nuclear fission (e.g., gun-type and implosion) and fusion (thermonuclear) weapons operate.
- Define the yield of a nuclear detonation.

4 Standards Addressed

CHEMISTRY 1

Students begin to conceptualize the general structure of the atom and the roles played by the main parts of the atom in determining the properties of materials. They investigate, through such methods as laboratory work, the nature of chemical changes and the role of energy in those changes. **C.1**

Describe that the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E=mc2) is small but significant in nuclear reactions. **C.1.42**

CHEMISTRY–PHYSICS

Describe that later, Austrian and German scientists showed that when uranium is struck by neutrons, it splits into two nearly equal parts plus one or two extra neutrons. Note that Lise Meitner, an Austrian physicist, was the first to point out that if these fragments added up to less mass than the original uranium nucleus, then Einstein's special relativity theory predicted that a large amount of energy would be released. Also note that Enrico Fermi, an Italian working with colleagues in the United States, showed that the extra neutrons trigger more fissions and so create a sustained chain reaction in which a prodigious amount of energy is given off. **CP.2.12**

PHYSICS 1

P.1

Students recognize the nature and scope of physics, including its relationship to other sciences and its ability to describe the natural world. Students learn how physics describes the natural world, using quantities such as velocity, acceleration, force, energy, momentum, and charge. Through experimentation and analysis, students develop skills that enable them to understand the physical environment. They learn to make predictions about natural phenomena by using physical laws to calculate or estimate these quantities. Students learn that this description of nature can be applied to diverse phenomena at scales ranging from the subatomic to the structure of the universe and include every day events. Students learn how the ideas they study in physics can be used in concert with the ideas of the other sciences. They also learn how physics can help to promote new technologies. Students will be able to communicate what they have learned orally, mathematically, using diagrams, and in writing.

P.1.32

Using the concept of binding energy per nucleon, explain why a massive nucleus that fissions into two medium-mass nuclei emits energy in the process. (Core Standard)

P.2

Students gain understanding of how the scientific enterprise operates through examples of historical events. Through the study of these events, students understand that new ideas are limited by the context in which they are conceived, that these ideas are often rejected by the scientific establishment, that these ideas sometimes spring from unexpected findings, and they grow or transform slowly through the contributions of many different investigators.

EARTH SPACE SCIENE 1

E.S.1.2

Differentiate between the different types of stars found on the Hertzsprung-Russell Diagram. Compare and contrast the evolution of stars of different masses. Understand and discuss the basics of the fusion processes that are the source of energy of stars. (Core Standard)

Indiana Department of Education. (n.d.). Indiana Standards and Resources: Sciences: Physics, Biology, Chemistry, and Integrated Chemistry and Physics; Family and Consumer Sciences and Health Careers Education. Retrieved from http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx

6 Vocabulary

Critical mass: Minimum quantity and configuration of nuclear material to initiate and sustain a nuclear detonation.

- **Fissile**: Highly susceptible to fission
- **Fission**: Splitting (of an atom's nucleus)

- **Fusion**: Joining together (of two nuclei to form a single nucleus)
- **Implosion**: Rapid collapse inward.
- **Yield**: The amount of energy released from a nuclear detonation, measured in units of tons of TNT.

7 Materials

Lecture material, Day 2 (found in Supplementary Material file)

8 Procedures

Lecture followed by examination.

A. Introduction

A number of nations have declared themselves members of the 'Nuclear Club', and others are suspected of building and stockpiling nuclear weapons.

The detonation of a nuclear device by a terrorist group would result in catastrophic physical effects and also cause tremendous psychological impacts worldwide.

It is essential for the emergency responder to be aware of the potential threat of nuclear hazards. This includes being able to understand the basic characteristics of nuclear weapons.

B. Development

On the first day the instructor will go over the introduction and the background of nuclear hazards, specifically nuclear radiation. On the second day will be a survey of the various types of nuclear weapons. The third day will encompass a discussion of the effects of nuclear weapons. On the fourth day the students will use a computer model to predict possible blast and fallout effects from a major nuclear detonation in the United States.

During Days 1-3 the class will take notes. They will also discuss how a nuclear incident would impact their community and the larger region (e.g., state, Midwest U.S.), should an attack ever occur there.

C. Practice

On the second day the material on nuclear radiation from the previous day will be reviewed. The instructor will give a lecture about nuclear weapons and the students will add it to their previous day's notes. The class will then brainstorm recommendations for preventing a nuclear attack by a terrorist organization. The teacher will add to this list recommendations that the students may not have included, which are in the lecture notes.

E. Accommondations (Differentiated Instruction)

Students who have visual, mobile or hearing impairments may need adaptive computer software to assist with using the computer and accessing the websites for information during the simulation. Students who are ELL as well as other students who may have developmental issues may need more scaffolding during the simulation to be able to complete it. This could be in the form of additional prompts for each question and a graphic organizer, perhaps a flow chart, to assist them in staying on track and managing the information.

For highly able/gifted students, you may want to make the simulation more abstract, by giving them less structured questions. You may just provide them with the scenario; let them figure out what needs to happen next, where to go for information, and so forth. Check in with them, ask some probing questions, and then give them the updates to the scenario.

F. Checking for Understanding

The teacher will ask questions throughout the presentation to check for understanding and have the students answer them. The correct answer will be provided right away, so that he/she will have an idea of if the students understand the material.

G. Closure

Careers in this area include:

- Directorate for Science and Technology: http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov
- U.S. Coast Guard: http://uscg.mil
- U.S. Immigration and Customs Enforcement: www.ice.gov

10 Evaluation

At the end of the unit, the students will be given a written exam that covers all of the topics covered.

11 Teacher Reflection

Teachers will reflect on lesson once it has been completed

12 Resources & Media

Lecture 2, Supplementary Material File

Directorate for Science and Technology:

- http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov
- U.S. Coast Guard: http://uscg.mil
- U.S. Immigration and Customs Enforcement: www.ice.gov